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# SPACER FOR A FUEL ASSEMBLY OF A BOILING WATER REACTOR

## Cross-Reference to Related Application:

This application is a continuation of copending International Application No. PCT/EP03/00081, filed January 8, 2003, which designated the United States and which was not published in English.

## Background of the Invention:

### Field of the Invention:

The invention lies in the boiling water reactor technology field. More specifically, the invention relates to a spacer for a fuel assembly of a boiling water reactor.

A spacer of the generic type, as it is known, for example, from U.S. Patent No. 4,999,153, is generally composed of inner webs that are fitted crossways into one another and a frame which surrounds the inner web and is formed from outer webs. In the outer webs, there are openings which are used to detach a film, or sheet, of coolant flowing along the inner wall of the fuel assembly channel and to divert the film of coolant inward, so that the coolant comes into contact with the fuel rods. The upper edge of the opening and the adjoining wall

region of the outer webs is pre-curved outward. This configuration is generally referred to as a gill.

To repair a fuel assembly, for example to exchange a fuel rod, it is necessary for the fuel assembly to be removed from the flow-guiding channel and subsequently reintroduced. Although the extent to which the gills project is such that a gap is present between the gills and the fuel assembly channel in the installed state, for example in order to allow radiation-induced growth in the width direction in the case of spacers made from Zircaloy, this gap does not prevent the gills from coming into contact with the inner wall of the fuel assembly channel. In this event, there is a risk of the projecting gills scraping along the inner side of the fuel assembly channel and in the process shaving off fine chips of metal or of being damaged themselves.

Summary of the Invention:

It is accordingly an object of the invention to provide a spacer for a fuel assembly of a boiling water reactor which overcomes the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and which provides an elegant solution and a remedy to the above problem.

With the foregoing and other objects in view there is provided, in accordance with the invention, a spacer for a fuel assembly of a boiling water reactor, comprising:

a frame formed with outer webs and inner webs oriented crossways with respect to one another;

gills formed on an outer side of the outer webs and projecting to a given extent from the outer side; and

a plurality of projections or bosses each formed by a bulge in a wall of the outer webs and projecting outwardly to a greater extent than the given extent of the gills.

In accordance with an added feature of the invention, the projections are formed geodetically below the gills.

In other words, the objects of the invention are achieved by virtue of the fact that a plurality of projections, which are formed by a bulge in the wall and project outwardly to a greater extent than the gills, are present on the outer side of the outer webs. This effectively prevents gills from being damaged or metal particles from being shaved off a flow-guiding channel when a fuel assembly is being introduced into the flow-guiding channel. It is preferable for the projections to be arranged below the gills. This prevents them from colliding with the upper edge of the flow-guiding channel when

the fuel assembly is being introduced into the flow-guiding channel, an operation which for radiation protection reasons has to take place at a level of several meters below the water level.

A similar purpose is served, in accordance with an additional preferred configuration, by the measure of providing the projections, at their lower edge, with a deflector lug which is angled off toward the center of the spacer. If the fuel assembly becomes twisted as it is being introduced into the flow-guiding channel, it is the deflector lugs which first come into contact with the top edge of the flow-guiding channel, thereby centering the fuel assembly and ensuring that the latter is introduced without friction. The projections then fulfill a dual role, since they simultaneously serve as an aid to threading in the fuel assembly. It is preferable for these projections to be arranged in the region of an inner web, so that the forces acting on them are transmitted into the inner web. Moreover, the inner web can be used both to support the projection and to support the deflector lug which is formed integrally thereon. For this purpose, the inner web has a first and a second supporting section, with the first supporting section extending into the projection, where it interacts with the inner wall of the latter, while the second section has an inclined edge against which the deflector lug bears.

In accordance with a preferred configuration, an inner web is fixed in the region of a projection by virtue of the fact that a slot which extends axially or in the longitudinal direction of the fuel assembly and is at least partially penetrated by the first supporting section is present in the wall of the projection. The slot is arranged in an outer-side recess of the projection. This has the advantage that a weld seam for joining the inner web to the outer web can be formed there without this seam projecting above the outer surface of the projection.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a spacer for a fuel assembly of a boiling water reactor, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description

of specific embodiments when read in connection with the accompanying drawings.

Brief Description of the Drawings:

Fig. 1 is a side view of portion of a spacer according to the invention;

Fig. 2 is a plan view oriented into the direction of the arrow II shown in Fig. 1;

Fig. 3 is a partially sectional view of portion of a spacer arranged close to a flow-guiding channel; and

Fig. 4 is a detail IV from Fig. 3 on an enlarged scale.

Description of the Preferred Embodiments:

Referring now to the figures of the drawing in detail and first, particularly, to Fig. 1 thereof, a spacer 1 for the fuel assembly of a boiling water reactor is composed of inner webs 2 which are fitted into one another crossways and a frame of outer webs 3 surrounding the inner web. The inner webs 2 form cells, through which, in the assembled state, fuel rods 4 are fitted. A plurality of gills 5 are formed on the outer side of the outer webs 3. These gills 5 comprise an opening 6, of which the upper edge and the adjoining wall section 7 are pre-curved outward. To prevent the gills 5 and/or the wall

section 7 from coming into contact with the inner wall of the fuel assembly channel when a fuel assembly is being introduced into a fuel assembly channel 8, projections 9, which are formed by bulges in the wall, project from the outer side of the outer web 3. The extent to which the projections 9 project is greater than the extent to which the gills 5 project, so that, in the assembled state or during the introduction of a fuel assembly into a fuel assembly channel 8, the distance 10 between the gills 5 and the inner side of the fuel assembly channel 8 is greater than the distance 11 between the projection 9 and the fuel assembly channel 8.

A deflector lug 13 which is approximately the in shape of a spatula and is bent inward is formed integrally on the lower edge 12 of the projection 9. In the outer side of the projection 9 there is a recess 14, wherein a slot 16 extending in the axial direction 15 is arranged. As can be seen clearly in particular from Figs. 3 and 4, a first supporting section 17, which projects beyond the side edge of the inner web 2 and extends into the projection 9, is formed integrally on the inner web 2 assigned to projection 9, the supporting section 17 having a basic shape which corresponds to the inner contour of the projection 9. A connecting lug 21, which projects through the slot 16, is formed integrally on the first supporting section 17. The connecting lug 21 is fixed to the outer web 3 from the outer side of the projection 9 by a weld

seam 18. A second supporting section 19, which has an inclined edge 20 with an orientation which is complementary to the inclination of the deflector lug 13, is formed integrally on the lower edge of the inner web 2. The deflector lug 13 is supported on this inclined edge 20.